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Review of Hot Spot Feasibility Study

October 13, 1989

By:

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I. Introduction

This report presents the results of an Arthur D. Little review of the "Draft Hot Spot Feasibility Study. New Bedford Harbor" (hereafter referred to as the Hot Spot Report) dated May, 1989 and submitted by Ebasco Services Incorporated to the U.S. Environmental Protection Agency under Contract Number 68-01-7250.

Arthur D. Little reviewed the draft report with respect to three areas:

- The validity of the PCB chemical concentration data underlying the report in terms of sampling design, sampling method, analytical method, QA/QC procedures and overall utility
- The accuracy of the transcription of data from the underlying studies and the accuracy with which points from various studies have been co-located on the maps
- The process used for drawing contour lines.

II. Chemical Concentration Data

A. Data Presented in Hot Spot Report

No sediment analytical data and no sampling information is included in the Hot Spot Report. (While Appendix A of the report, entitled "Sediment Analytical Data" states that "Corresponding tables to this section will be provided by Battelle Northwest at a later date," no such data have been provided.) In the absence of information regarding sampling design, sampling method, QA/QC procedures and results and analytical approach, it is impossible to assess the validity of the interpretations presented in the Hot Spot Report. The sediment analytical data required in order to evaluate the Hot Spot Report include not only the quantity of PCBs but also the qualitative identification of the PCBs observed. Failure to distinguish among PCBs conceals important information relating to toxicity as well as sources of contamination. It also conceals the fact that there exists no credible evidence for the presence of Aroclor 1016 in the harbor.

B. Referenced Studies

The Hot Spot Report states (p. 2-7) that "five sediment sampling data sets were used to determine the nature and extent of PCB contamination in sediments of the Acushnet River Estuary ... because of their consistent sampling and analytical procedures":

- U.S. Coast Guard Sediment Sampling Program (1982)
- USACE FIT Sampling Program (1986)
- Battelle Hot Spot Sediment Sampling Program (1987)
- USACE Wetlands and Benthic Sediment Sampling Program (1988)
- USACE Hot Spot Sediment Sampling Program (1988).

No reports with titles that exactly correspond to these data set descriptions are listed in the bibliography of the Hot Spot Report and no studies with these titles have been made available despite repeated efforts to obtain data.

More specifically, information concerning the "Battelle Hot Spot Sampling Program (1987)" or the "USACE Wetlands and Benthic Sediment Sampling Program (1988)" has not been made available in any form. It is therefore impossible to review the adequacy of the statistical sampling design, the procedures for locating sample points, the sampling methods employed, the sample chain-of-custody, the analytical methods used, or the Quality Assurance/Quality Control procedures and results for any data that may have been taken from these sampling and analysis programs.

Any conclusion drawn from these data cannot be accepted until the underlying studies have been analyzed.

However, a comparison of sample numbers and the approximate location of various data points suggests that the remaining three data sets cited in the Hot Spot Report are, at least in part, drawn from studies that the Government has previously made available.

- "U.S. Coast Guard Sediment Sampling Program (1982)" appears to refer to the results of sampling conducted in April 1982 by the U.S. Coast Guard and summarized in a memorandum ("Acushnet River sediment sample analysis report") dated 11 June 1982
- "USACE FIT Sampling Program (1986)" appears to refer to the results of sampling conducted by the U.S. Army Corps of Engineers in July through October 1985 and summarized in a report entitled "New Bedford Harbor Superfund Site. Acushnet River Estuary Study," authored by Brian J. Condike and dated June 1986.
- "USACE Hot Spot Sediment Sampling Program (1988)" appears to refer to the results of sampling conducted by the U.S. Army Corps of Engineers on an unknown date. Some information concerning this sampling was provided in a document entitled "Superfund Site, New Bedford Harbor, Massachusetts. Chemical and Physical Analysis of Sediments From Hot Spot Area. November 1987."

On the assumption that the above inferences are correct, the following sections present a brief analysis of the quality of the data that may have been used in developing the Hot Spot report.

C. US Coast Sediment Sampling Program (1982)

The "U.S. Coast Guard Sediment Sampling Program (1982)" sample numbers and locations, shown in maps A-1 through A-3 in the Hot Spot Report, appear to correspond to those in the study previously reviewed as "USCG, April 1982." Both the samples described in the "USCG April 1982" package and the samples shown as solid circles in Figures A-1 and A-1A of the Hot Spot Report are consecutively numbered from 1 to 33 and there is a rough correspondence between the sample locations presented in the 1982 Coast Guard memorandum and those shown in Figure A1-A of the Hot Spot Report. (However, see Section B, below.) This supports the assumption that the April 1982 Coast Guard sampling is the data set to which the Hot Spot Report is referring.

The information provided in USCG, 1982, including supporting documentation (laboratory records and chromatograms), have been reviewed in some detail and following conclusions can be drawn:

- There is no evidence that the work was carried out according to a statistical sampling design. In the absence of such information, the use of judgmental or haphazard sampling can be presumed. The data therefore cannot be used to draw inferences concerning the PCB distribution in the estuary.

- The U.S. Coast Guard laboratories failed to implement even a minimal program of Quality Control replicate samples, calibration standards, or blank samples, rendering the reported data unreliable.

- The U.S. Coast Guard did not use standard methods for the identification and quantification of PCBs. Two of the methods used (TLC and HPLC) were unsuitable for the purpose and the third (GC) was performed incorrectly; the Coast Guard (usually but not consistently) reported the results as an arithmetic mean of three individually invalid numbers for each sample analyzed.

- Overall, this data set is unreliable and totally unsuitable for drawing inferences concerning PCB distribution in the estuary.

D. USACE FIT Sampling Program (1986)

Samples and sample numbers shown in Figures A-1 through A-3 in the Hot Spot Report and identified therein as "USACE Samples - Group 2," appear to be from the study previously as "COE 1985 Sampling," and described in the June 1986 report of Brian J. Condike. These include samples shown on the maps in the Hot Spot Report as circles with crosses in them. For example, sample number 9914A can be tracked back to the same code in the underlying study (June 1986 Condike report). However, some of the crossed circles do not match anything in the Condike 1986 report, see e.g. AD 592.

The data (including laboratory records and chromatograms) from the 1985 COE sampling effort have been reviewed in some detail. The following conclusions can be drawn:

- Cores samples were collected according to a systematic sampling plan. However, the procedures used to select subsamples from the cores ("visual classification") for determination of PCB content were subjective and probably biased the results upward. The concentration results reported for this study therefore do not reflect a statistical design and are unsuitable for drawing inferences about the distribution of PCBs within the estuary.

- The PCB concentrations reported for individual subsamples in this study are reasonably well supported by laboratory Quality Control data. However, no field duplicates were analyzed and no calibration data were provided to allow assessment of the correctness of the quantification.

E. USACE Hot Spot Sediment Sampling Program (1988)

The comparison of sample numbers, suggests that the USACE Hot Spot Sediment Sampling Program (1988) incorporates some of the data previously made available in a report entitled "USACE-NED, Superfund Site, New Bedford Harbor, MA, Chemical and Physical Analysis of Sediments from Hot Spot Area," dated November 1987. Samples numbered 1657 through 1764 seem to be those shown as solid triangles on the Hot Spot Report maps A-1 through A-3. The following comments assume this is the correct underlying study.

However, details of the sampling design, sampling methods, analysis or Quality Control procedures were provided in the 1987 report, and no conclusions regarding PCB distribution can be drawn from these data.

- The USACE sampled and analyzed cores from 41 separate grid squares. There is no evidence that a statistical approach was used to develop the sampling design.

- In selected grid squares, USACE took 4 cores per square as opposed to the usual 1/square. These "replicates" (actually one sample each from 4 subsquares within the grid square) showed relatively poor reproducibility. For example:

Grid 11B/IA:	0-12"	3892, 4324, 5223, 9842 ppm
	12-24"	0.05, 2.0, 9.0, 31 ppm
Grid 7A/JB:	0-12"	66314, 71699, 73105, 102099 ppm
	12-24"	193, 11386, 27304, 42277 ppm

These wide (more than a factor of 500 in one case) swings in PCB content, even within a single grid square at a single depth, dramatically illustrate the danger of trying to interpolate between data points for adjacent grid squares.

II. Accuracy of Transcription

A. Chemical Concentration Data

The draft Hot Spot Report does not contain any tabulation of the data used in developing the contours of PCB concentration. Therefore, it is impossible to verify whether the contamination assessment is based on accurate transcription of the data from the underlying studies.

Nor can accuracy in transcription be presumed. In Figure 2-8 of the Hot Spot Report, 24 specific points are identified with PCB concentrations. Sixteen of the concentrations shown appear to be for samples from the USACE 1988 sampling. (The others are presumably from one of the studies not yet made available.) Of these 16 values, one (6%) appears to have been transcribed incorrectly - 37,334 ppm shown in figure, 34,334 ppm in underlying study.

B. Sample Depths

In addition to actual and potential transcription errors in chemical concentration data, the Hot Spot Report frequently misrepresents the sample depths compared to the underlying study. For example:

The following samples are shown in Map A-1 and/or Map A-1A, which are labelled "Depth: Zero to 12 Inches". These samples do not represent integration over the top 12" of sediment and do not represent the average PCB concentration in the top foot of sediment at the sampled location.

Sample No.	Actual Depth	Sample No.	Actual Depth
9941A	0-8"	0052A*	0-1"
9902A	0-6"	0052E*	12-13"
9877A	0-6"	0052D*	Not given
9914A	0-14"		
9918A	0-24"	*Shown as one data point.	

Furthermore, all of the sample depths for the U.S. Coast Guard 1982 sampling are misrepresented in Figures A-1 and A-1A. The Coast Guard 1982 data were not for 0-12" depth. The Coast Guard analyzed a 0-1", a 5.5-6.5", and (sometimes) another, deeper 1" slice from each core. In no way can these be represented as a concentration over the top foot of sediment. Furthermore, the Hot Spot Report gives no indication as to how the data for these multiple subsamples of the Coast Guard cores were combined (e.g., was the value used the average of the 0-1", 5.5-6.5" and/or deeper slices?).

The following samples are shown in Map A-2, which is labelled "Depth: 12 to 24 Inches." The underlying study shows that at least a portion of each of these samples corresponded to a depth of less than 12".

Sample No.	Actual Depth
0052D	Not known*
9938A	0-24"
9927A	0-22"
9877B	6-18"
9840A	0-24"
9953B	8-20"

* How can this sample be both 0-12" (Map A-1) and 12-24" (Map A-2)? The underlying study for the COE 1985 sampling (1986 report) does not report a depth for sample 0052D. However, 0052A is reported as 0-1", 0052C as 5.5-6.5", and 0052E as 12-13"; it seems probable that 0052D was a slice somewhere in the 6.5-12" depth of this core.

The following samples are shown in Map A-3, which is labelled "Depth: 24 to 36 Inches." The underlying study shows that at least part of the sample was from a depth of less than 24".

Sample No.	Actual Depth
9925B	18-28"
9877C	18-36"
9922B	15-27"

C. Sample Location Data

The Hot Spot Report and its maps provide no grid markings or coordinates for sample points. It is therefore impossible to tell whether the points from different sampling events have been accurately co-located. This is critically important in determining whether the contour intervals drawn are even approximately correct.

However, some discrepancies compared to the underlying studies can be noted. For example:

- Figure 1 (attached) is a modification of Map A-1A from the Hot Spot Report, showing only those data points attributed to the U.S. Coast Guard (1982) sampling. Figure 2 (attached) is a copy of the map provided in the original Coast Guard sample results memorandum. It seems evident that the relative positions of the sample locations, with respect to each other and to the shoreline, are not the same in these two maps. Compare, for example, the line drawn through sample sites 1,2, and 5 and/or through sites 9, 10, and 11 in Figure 2 with the corresponding lines and locations shown in Figure 1. Also, in Figure 2, a line drawn through sites 16,15,14, and 13 intersects the location of site 22; in Figure 1, a corresponding line intersects the location of site 23.

- Figure 3 (attached) is a different modification of Map A-1A from the Hot Spot Report, showing only those data points attributed to the USACE Hot Spot (1988) samples. Figure 4 (attached) is an annotated copy of a drawing (grid) provided by the U.S. EPA along with "Chemical and Physical Analysis of Sediments From Hot Spot Area, November 1987, USACE-NED." In Figure 4, the darker, boldface number in each grid square is the PCB concentration as entered by USACE; the lighter number is each square is the sample number (entered by Arthur D. Little), according to the table ("Sample Location and Identification") provided in the cited document. Note in Figure 4 that Sample #1683 is located at grid square 10A/IB, between samples #1681 (square 10A/IA)and #1715 (square (10A/JA). However, turning back to Figure 3, it is clear that sample #1683 is not shown between #1681 and #1715; no sample is shown at that location (empty circle drawn in Figure 3). Instead, sample #1683 (circled) is shown in the Hot Spot Report map as adjacent to sample #1679 (which USACE shows as grid square 11B/IB). This is very different from the location assigned to this sample in the underlying study.

It has not been possible to confirm whether there are additional, less obvious errors in the Hot Spot Report treatment of sample locations.

III. Critique of the Process for Drawing Contour Lines

A. Combining Data Across Studies

The approach taken in the Hot Spot Report is based upon a false assumption that the results of multiple studies, years apart, using varying methods for sampling and analysis can be viewed as a single coherent body of data. The Report fails to provide information about the intent, purpose, and (lack of) statistical design of the studies from which the data were drawn. It appears to assume that all of the values used are equally accurate and that inferences can be drawn from the data set as a whole. This is not true, especially because the underlying studies were not conducted in accordance with statistically-designed sampling plans.

There is no evidence that the samples for which data were taken were collected with the element of randomness necessary in probability sampling. This element of randomness is essential to guarantee freedom from bias and allow statistical inference. There is evidence in the underlying studies that judgmental or haphazard sampling (or subsampling) was performed. This almost guarantees that the results will be biased and unsuitable for drawing any inferences concerning the state of the Acushnet Estuary.

The approach taken in the Hot Spot Report also incorrectly implies that the measurements made in the various studies can be accurately co-located on a single set of maps. However, in at least one of the cited studies (U.S. Coast Guard Sediment Sampling Program. 1982), the underlying study locates sample sites pictorially (as hand-drawn circles on a map, Figure 2). No coordinates (UTM, latitude/longitude, or Lambert grid) are given in the underlying study.

B. Contouring Method

The method used for contouring PCB analytical data from sediment samples (as outlined in the May, 1989 Feasibility Study) is a simplistic approach based on arbitrarily-chosen (from a statistical standpoint) contour intervals. The distance between individual data points is equally divided by the number of contour intervals separating the given values. For instance, a value falling in the 0 to 50 ppm range will have a single contour line spaced equally between it and a data point with a value of 50 to 500 ppm. It follows then, that the same original data point will have two equally spaced contour lines between it and a point falling in the 500 to 4,000 ppm range. This approach, while valid as a first pass to determine orders of magnitude, is entirely inadequate for more detailed evaluation of analytical data. The following bulleted items outline shortcomings of the procedure used in the Feasibility Study and suggest alternative approaches.

- The applied contour method is not statistically rigorous and does not adequately "weight" the data for accurate assessment of directional inhomogeneity (e.g., non-random distribution of contamination). This simplistic approach has purposely not accounted for the factors which provide "fabric" or linearity to these data, such as tidal currents, ongoing sedimentation, and channeling, thereby simply cutting across these natural bounding conditions.

- The use of only three contour levels with an arbitrary upper threshold of 4,000 ppm PCB has masked many crucial details which may provide insight into the ongoing dynamic movement of PCBs within the sediment and water column. A more appropriate contour interval might be half-step log intervals (i.e., 0-50, 50-100, 100-500, 500-1,000, 1,000-5,000, 5,000-10,000 ppm, etc.).

- The Feasibility Study contouring approach does not incorporate a linear regression analysis to correlate PCB concentration with distance down the primary transport pathway. This information is useful in assessing the directional inhomogeneity of the data. A linear regression analysis might also help to identify any non-"hot spot" sources of PCBs into the estuary.

- Accurate assessment of sediment volume falling above a given lower contaminant threshold is impossible utilizing the Feasibility Study approach. Given the projected costs of remediation for the "hot spots" ($10-15 million), an error of 15-20% in contouring accuracy could result in errors in projected expenditures of several million dollars.

- The simplistic contouring approach provides no measure of uncertainty in the contoured data and it provides no means for determination of the adequacy of sampling density.

- A statistical approach known as kriging could adequately address these issues by assigning preferred fabric or linearity to data, thereby accounting for directional inhomogeneity.

- Kriging could provide a minimum variance, unbiased linear estimator of the distribution of PCB contamination between any two points of known value in any given geometry. In addition, it can provide an explicit measure of uncertainty in the contoured data by incorporating error bands on all contours, and if more data are needed, kriging will provide guidance for optimum placement of additional sampling stations.

- A previous kriging effort (Metcalf & Eddy, 1983) provided no detail for delineating hot spots and was effective only in defining regional contaminant trends.

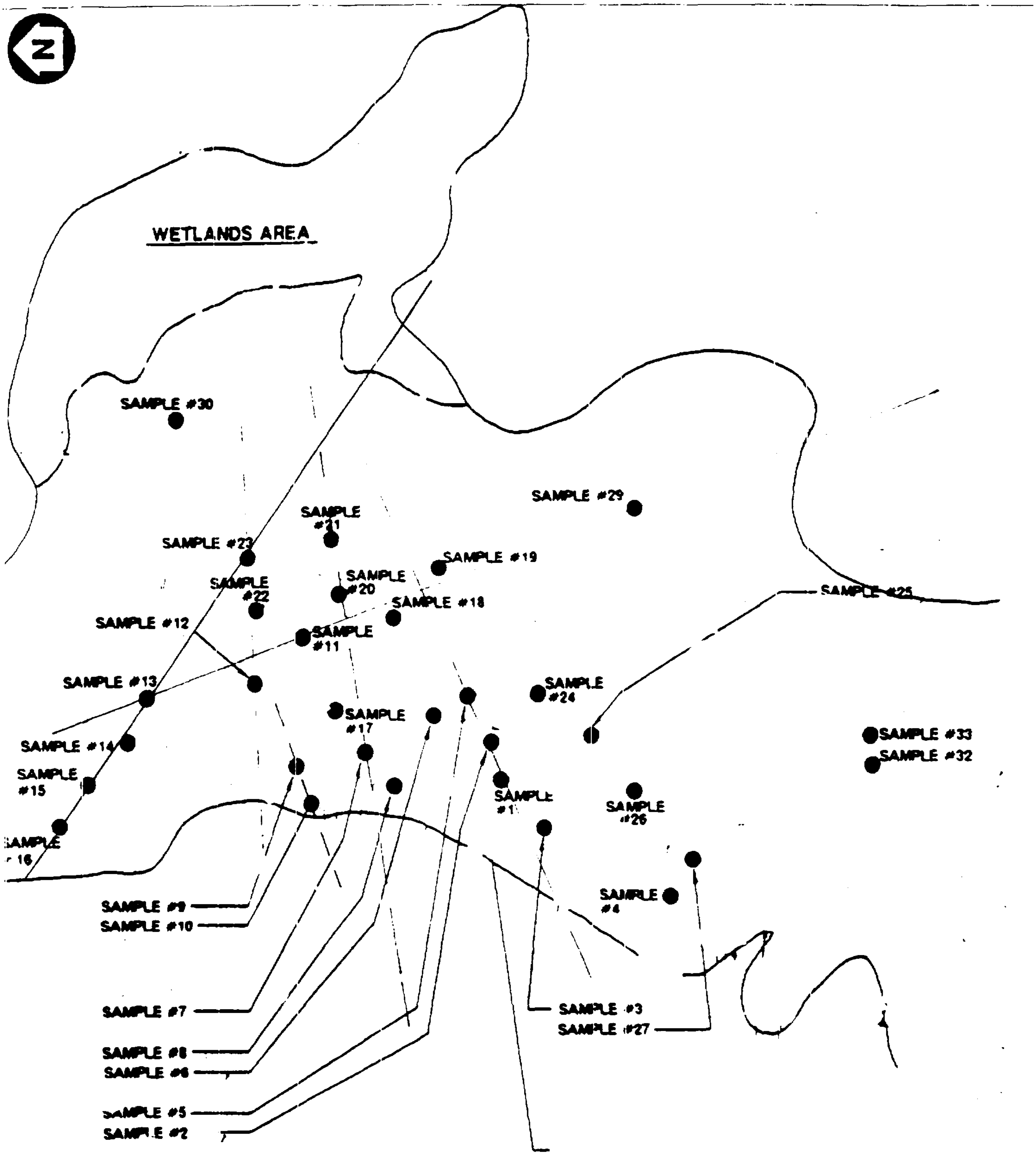

FIGURE 1. Modification of Hot Spot Report Map A-1A, Showing Only Samples Attributed to USCG, 1982

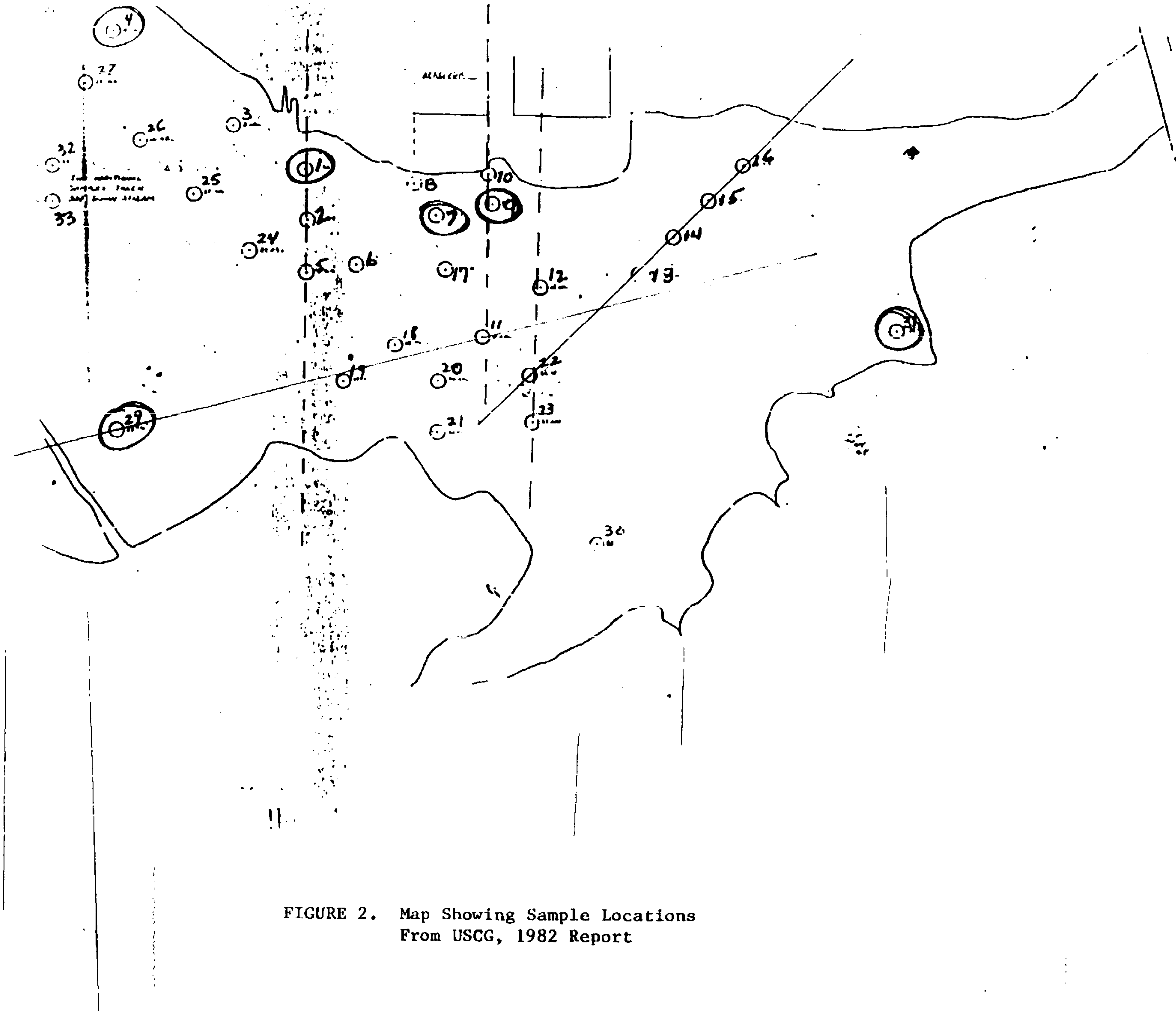

FIGURE 2. Map Showing Sample Locations
From USCG, 1982 Report

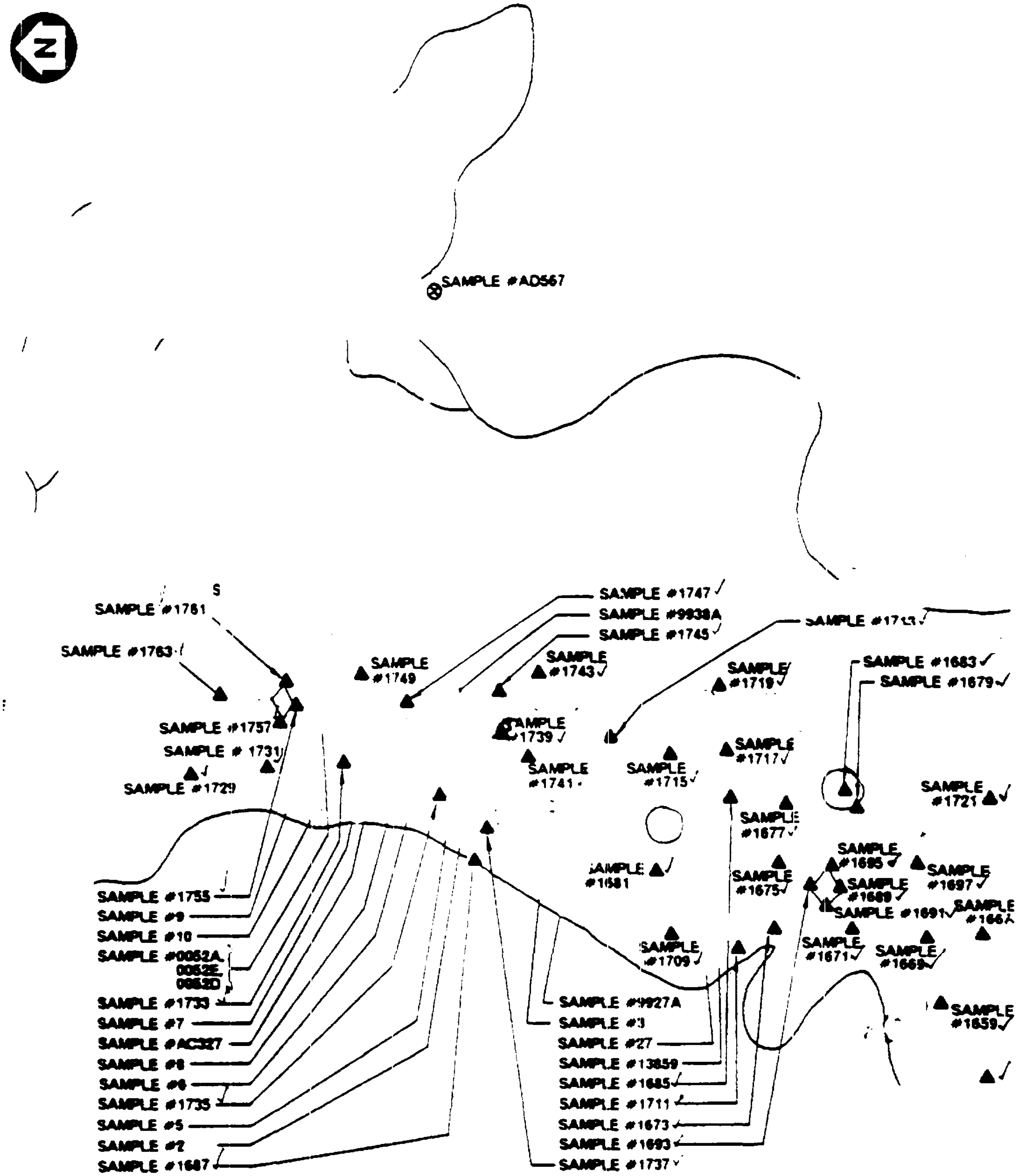

FIGURE 3. Modification of Hot Spot Report Map A-1A, Showing Only Samples Attributed to USACE Hot Spot, 1988

Judith C. Harris

Background

Dr. Harris is a Vice President of Arthur D. Little, Inc., and a Director of the Environmental, Health, and Safety Practice. She is a senior consultant in the Chemical and Life Sciences Section, with 17 years experience in environmental chemistry. She has been responsible for program management and for technical research and development on major assignments for government and private sector clients, involving waste characterization, environmental fate studies, regulatory compliance, risk assessment, and environmental litigation. Dr. Harris is currently manager of the Quality Assurance Unit in Arthur D. Little's Chemical Sciences Section and Chair of the Quality Assurance Board for the company's Environmental, Health and Safety Practice.

As manager of multidisciplinary environmental programs directed towards waste characterization, management and environmental impact, she has maintained a thorough current awareness of evolving Federal and State laws and regulations. She is responsible for applying that understanding both to the design of experimental and research programs for clients and chemical laboratory operations.

Experience

Dr. Harris has supervised the development and implementation of an extensive Quality Assurance program for a large U.S. Army Toxic and Hazardous Materials Agency analytical program in support of environmental monitoring and remediation.

She is an established team leader in Arthur D. Little's environmental auditing activities. Her specific responsibilities include the inspection and evaluation of industrial operations for environmental compliance, especially with regard to the management and control of toxic substances.

Dr. Harris has managed measurement portions of a long-term EPA field investigation of the destruction of chemical wastes in commercial scale incinerators and achieved national recognition for the authorship of the EPA manual, "Sampling and Analysis for Hazardous Waste Combustion," and the 1987 EPA Report to Congress, "Municipal Waste Combustion Study: Sampling and Analysis of Municipal Waste Combustors."

Judith C. Harris (Continued)

As Program Manager, Dr. Harris provided technical assistance to a large commercial client confronted with major environmental litigation relating to three inactive chemical waste disposal sites. She managed tasks that involved generation of high quality data in Arthur D. Little laboratories, at subcontractor laboratories, and in the field. Dr. Harris also interacted with the client managers and engineers, their attorneys, and a broad mix of special consultants to help ensure that the overall program and implementation plans were responsive to the interests of the Government while still representing cost-effective investments in environmental protection on behalf of the client.

She has provided technical support to a legal firm representing one of the Potentially Responsible Paries connected with a Superfund site. Dr. Harris's principal role in this assignment is the critical review of the monitoring data developed to document PCB contamination at the site in order to determine the extent of any natural resource damage.

She managed the preparation of exposure and risk assessments for the EPA Monitoring and Data Support Division on dichlorobenzene, polycyclic aromatic hydrocarbons and other compounds in the environment. These documents address the sources, releases, and concentrations of environmental pollutants, their environmental fate, toxicity, exposure, and associated risk.

Dr. Harris has had extensive experience in technology transfer to both technical and lay audiences. She has been the author of numerous highly technical reports, presentations, and publications. She has conducted studies and provided expert testimony in formal and informal public hearings concerning exposure and risk associated with environmental pollution. She has also developed and presented EPA training programs for permit writers and the regulated community with respect to sampling, chemical analysis and Quality Assurance/Quality Control. Her experience includes the preparation of Quality Assurance Program.Project Plans for substantial field and laboratory measurement programs.

Education

Program for Management Development, Harvard University Graduate School of Business Administration, 1982
Ph.D., Physical Organic Chemistry, Washington University, 1970
A.M., Chemistry, Washington University, 1967
A.B., magna cum laude, Mount Holyoke College, 1965

Professional Affiliations

American Association for the Advancement of Science
American Chemical Society
Chair, American Society of Mechanical Engineers PTC-45 Committee on Municipal Waste Combustor Emissions Testing
Member, EPA Scientific Advisory Board Subcommittee on Products of Incomplete Combustion

Work Experience

Arthur D. Little, Consultant, 1975 - present
Harvard University, Division of Engineering and Applied Physics, Lecturer and Research Fellow, 1971-1975
Mount Holyoke College, Visiting Assistant Professor, Fall Semester, 1970
Brandeis University, National Science Foundation Postdoctoral Fellow, 1970-1971

Background

Ms. Coons has been a member of the Chemical and Life Sciences Section of Arthur D. Little, Inc. since 1978. Her areas of expertise include: environmental fate and transport; exposure and risk assessment; hazardous waste characterization; analytical chemistry; data management and interpretation; and QA/QC evaluation. Prior to joining Arthur D. Little, Inc., Ms. Coons was employed in biochemical research at Massachusetts General Hospital and University of New Mexico School of Medicine.

Ms. Coons is a member of the Board of Health (1983-present) and the Refuse Disposal Task Force (1988-present) in Concord, MA. In this capacity she has chaired or participated in numerous public meetings and hearings. She has dealt with issues related to management of hazardous materials, environmental monitoring, evaluation of underground storage tanks, remedial investigations and cleanup activities at local contaminated sites, and disposal options for municipal solid waste.

Experience

Ms. Coons was a key participant in an extensive U.S. Air Force program directed at evaluating health hazards associated with contamination of drinking water supplies on and off Air Force installations. The project resulted in an Installation Restoration Program (IRP) Toxicology Guide addressing over 70 chemicals or mixtures of chemicals including hydrazine. The environmental fate, exposure, and toxicology of each chemical or mixture of chemicals were evaluated; potential hazards or risk were also addressed. The chemicals represented in this task included chlorinated solvents, benzenes, naphthalenes, phthalates, dioxin, PCBs, pesticides, complex fuel mixtures, crankcase oils and major fuel additives. Ms. Coons' contributions to this effort included summarizing relevant physico-chemical properties, defining significant environmental fate and transport processes, documenting appropriate analytical techniques and preparing the final report. For the U.S. Army, Ms. Coons prepared summaries of the environmental properties and behavior of selected inorganic elements.

Under contract to the U.S. EPA, Arthur D. Little, Inc. developed a methodology for assessing exposure and risk associated with environmental pollutants, and prepared exposure and risk assessments for a number of chemicals. Technical literature was reviewed and assessed. Sources of release were identified, environmental loadings were estimated, environmental fate and transport processes were analyzed, and several modeling approaches were used to predict the expected distribution of the pollutant in the environment. Human toxicological effects, as well as effects on other biota, were also evaluated for each pollutant. These data were used to develop risk assessments for exposure to these environmental pollutants. Ms. Coons prepared the environmental fate chapters of many of these reports and directed the work on the documents for two groups of organic chemicals. Ms. Coons also participated in exposure and risk assessments evaluating the impact of several proposed resource recovery facilities. The effects of airborne stack and fugitive dust emissions from the resource recovery plants were evaluated. Particular emphasis was placed on defining the impact of dioxin/furan emissions on the health and safety of nearby residents and employees.

Ms. Coons has participated in a number of projects studying the disposal and treatment of potentially hazardous wastes. For the U.S. EPA, she managed a large sampling and analysis task directed at the characterization of waste streams from selected industries to determine whether these wastes should be classified as hazardous and regulated under RCRA. For the commercial sector, Ms. Coons has contributed to projects addressing management of hazardous waste and waste disposal sites,waste characterization, and evaluation of hazardous waste classification. Her specific responsibilities have included the compilation and interpretation of analytical data and the preparation of reports to address a variety of aspects of the problem definition and site management efforts.

For a law firm representing an industrial client in environmental damages litigation, Ms. Coons has provided broad technical support in areas of data interpretation and data quality analysis. Her specific responsibilities have included: evaluation of monitoring program design, review of sampling and analysis procedures, examination of analytical data generated, and critical review of the confidence (usability) of the data and the methods of presentation.

Ms. Coons is currently the Lead Chemist for Arthur D. Little's contract with the U.S. EPA Region 1, under the Alternative Remedial Contracts Strategy (ARCS). The Scope of Work includes the entire remediation process (site characterization through remedial implementation) at selected NPL sites in EPA Region 1. Her specific responsibilities in the program include: coordinating sampling activities, scheduling analytical services, managing data validation efforts and preparing data usability reports.

Education

A.B., Chemistry, Bowdoin College, 1973
Additional studies, Mass. Institute of Technology and University of New Mexico

Professional Affiliations

Board of Health, Concord, MA
Refuse Disposal Task Force, Concord, MA

Scot A. Foster

Background

Mr. Foster is a member of the Earth Sciences and Engineering Unit in the Environmental Management Section at Arthur D. Little, Inc. His ten years as a professional geologist include radioactive waste site performance assessment, site characterization studies, geochemical sampling of various matrices, geophysical surveys, and geologic mapping. Mr. Foster has had management and oversight responsibility for large-scale exploration programs and contaminant assessment studies where he conducted program design, budgeting, implementation and technical evaluation. Among his current activities, Mr. Foster is involved in the assessment of environmental, health and safety liabilities at a wide variety of industrial sites, both domestic and international.

Experience

For the Environmental Protection Agency, Mr. Foster has provided technical support for performance assessment of high-level and transuranic radioactive waste disposal sites. His involvement has included radionuclide escape pathway analysis, radiological assessment and development of exposure scenarios for the WIPP site, and assessment of long-term performance evaluation tests. He is responsible for the development of NEFTRAN and REPRISK computer code in support of release scenario modeling.

In support of a corporate acquisition, Mr. Foster conducted an assessment of environmental liabilities at a minerals processing plant in northern Spain. This work included a detailed analysis of operational systems and wastes generated. Following the assessment, he developed and managed a site sampling program to further characterize the potential soil and groundwater contamination. An understanding of Spanish hazardous waste and water quality regulations was necessary for this work.

In support of site evaluation for a proposed Class I waste facility in southern California, Mr. Foster analyzed siting criteria, evaluated geologic and hydrogeologic data, and defined critical issues concerning potential geologic hazards.

For major mining companies and as a consulting geologist, Mr. Foster designed and implemented geochemical and geophysical exploration programs in the southeast U.S., Montana, Idaho and Alaska. His responsibilities involved management and field program oversite, including drilling, geochemical sampling and geologic mapping. In addition, Mr. Foster was responsible for process and economic evaluation of current mining and refining operations in regions of exploration interest.

As a member of an Arthur D. Little team working for a major investment corporation, Mr. Foster conducted due diligence environmental assessments of several automotive parts manufacturing facilities. The assessments involved determination of potential liabilities resulting from waste disposal practices, regulatory compliance and nature and condition of underground storage tanks.

Education

B.S., Geological Sciences, University of Maine, 1978
M.S., Geological Sciences, University of Idaho, 1983

Professional Affiliations

- Registered Professional Geologist - North Carolina
- Registered Professional Geologist - South Carolina
- Member - National Water Well Association